かにパルサーの太陽掩蔽による 5-14 Rs におけるコロナプラズマ密度測定

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Coronal plasma density measurements at 5-14 Rs from solar occultation of Crab pulsar

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Dispersion measures (DMs) derived from pulsar observations provide information of line-of-sight (LOS) integrated density of the intervening plasma. We made DM measurements of Crab pulsar in 2018 during solar occultation in 2018 using the 327-MHz radio-telescope at Toyokawa (called SWIFT, Tokumaru et al., 2011). The aim of these measurements is to investigate the coronal plasma density near the Sun in the current cycle; SC24; which is the weakest in the past 100 years. The LOS of Crab pulsar approaches the Sun as close as ˜5 Rs, passing over the South pole in mid-June every year. We determined the DM by maximizing a peak height for each giant pulse (GP) detected from Crab observations, and then taking a mean of the values obtained for a given day. The observed DMs during the period around the closest approach; i.e. June 13-19, 2018, showed excesses over the interpolated level from two adjacent DMs which were taken at >50 Rs. This excesses were considered as the effect of the solar corona. We fit a spherically symmetric model of the coronal density, which was given as a power law function of the radial distance, to the observed DM data. The best fit model were found to be generally consistent with past studies which reported Crab pulsar observations in 1969-1973. This may suggest that no significant change occurred in the coronal plasma density despite marked decline of the solar activity in SC24. However, data obtained here are associated with large estimation errors, and the number of the data is limited. Therefore, we need to collect the data further to deduce a conclusion about the difference between the current and past cycles. We compared the DM data with LASCO coronagraph observations and also with solar wind speed data derived from ISEE IPS observations. As result, a high level of the DM excess observed on June 19 was found to likely represent the high density plasma associated with the streamer and the slow solar wind near the equator. No significant increase in the scattering timescales of giant pulses was observed during the solar occultation. Since the variation of giant pulse occurrence rates correlated with that of scattering timescales, it was ascribed to the scattering effect by the interstellar medium.